

probably to be found in the ligno-celluloses; another part owes its origin to the albuminoid constituents of the plants that contributed to its formation, acidic bodies resulting from the degradation of the latter may be conceived having entered into chemical union with acid decomposition products of ie other to give highly complex compounds of carbon, hydrogen, oxygen, nitrogen, and sulphur; and these, along with others consisting of carbon, hydrogen and oxygen alone, now constitute the main portion of the combustible matter. At one time the mass, or a portion of it, has apparently existed in a state of plasm or jelly, and this circumstance accounts for the fact of fundamental importance that the burning of coal, or of its derivatives char and coke, is the fire is a slow and difficult matter in comparison with wood and charcoal, which possess a tubular structure that admits a ready penetration of air. Coals when destructively distilled in the furnace leave a charred mass of lumps which, though not gas-tight in the absolute sense, are practically impermeable by the air current. Combustion of this fixed carbon is thereby restricted to that portion of the outer surface of the pieces which is exposed to air passing through the furnace.

**Classification of Coals.**—It is not possible to make strict or scientific classification of coals, since the distinguishing characteristics shade insensibly into one another, and a single seam may contain sections that are bright and dull, yield variable proportions of gasifiable constituents, and exhibit a greater or less degree of coherence in their cokes. For use as fuels they may be rouped into (a) the soft coals, generally free burning and yielding more than 45 per cent of gasifiable constituents reckoned on the combustible matter; (&) the light steam coals, which may either be free burning or cake on the fire and yielding from 36 to 45 per cent of volatile matters; (c) the heavy steam coals similar to (6), but yielding only from 15 to 36 per cent of volatiles; and (d) the semi-anthracites with n per cent to 15 per cent, and anthracite with less than u per cent of volatile matters. Increase of fixed carbon is generally accompanied by less combustibility, but not by lowered calorific value.

**Sampling of Coal.**—For the testing of coal and coke the importance of careful sampling cannot be overrated. Coal is essentially an irregular mineral. Apart from the possibility of large pieces of stone and shale—so-called "dirt"—being included, the actual coal substance is not homogeneous. In the case of screened coal the portion passing through the screen generally contains a higher ash than the round coal. In railway wagons during transit the finer portion settles to the bottom and contains more than the average ash. Two consecutive boiler trials carried out with coal from the same leap, bunker, or truck may on this account show differences in the calorific values of the coal used amounting to as much as 10 per cent.

For large coal, sampling may be done by taking half-shovelfuls from the leap at the time of weighing each lot for use in a boiler trial, the pieces being first broken and a proportion of large and small taken. The aggregate of samples is broken up, well mixed, and reduced by quartering. Washed small coal, washed nuts, peas, and dross are generally more regular in composition